

BRYOPHYTE FLORA OF BARDDHAMAN DISTRICT, WEST BENGAL

P. K. BHATTACHARYYA

Deptt. of Botany, Burdwan University, Burdwan 713104

A B S T R A C T

The present paper deals with the first information on the bryophyte flora of Bardhaman district, West Bengal. Altogether 26 species under 18 genera belonging to 13 families have been reported. Each species is appended with relevant field data, necessary illustrations and diagnostic features. *Archilejeunea planiuscula* (Mitt.) Staph. and *Lejeunea boninensis* Harikawa are the new records to the known flora of the Indian Union.

INTRODUCTION

The district Bardhaman is an important political and administrative unit of the State of West Bengal. Geographically the district is located between north latitude 22° 56' to 23° 53' and east longitude 86° 48' to 88° 25'. The present area of the district is 7001.4 sq km. From a regional point of view the Bardhaman district is a transitional zone between the Bihar plateau, which constitutes a portion of peninsular shield in the west and the Ganga-Brahmaputra alluvial plain in the north and east. Towards south, the alluvial plain merges with the Kasi-Subarnarekha-Baitarani deltaic plains. This district lies mainly between the Ajoy, the Bhagirathi and the Damodar rivers. It is bounded on the north by the districts of Santal Pargonas, Birbhum and Murshidabad, on the east by Nadia, on the south by Hooghly, Bankura and Purulia and on the west by Dhanbad (Bihar) districts. The western part of the district, which receives an average of less than 1300 mm annual rainfall, is comparatively drier than the eastern part (Kanksa to Kalna) that receives 1400-1500 mm of rain annually. The climate is warm and humid.

Previous works on the bryophyte flora of the district of Bardhaman:

Except for a few occasional works by Kachroo (1958) on the liverworts and Gangulee (1971-1980) on the mosses, no systematic account has appeared on the Bryophyte flora of Bardhaman district. During the last part of the 20th century, the author and his coworkers (1971, 1986, 1996, 1997, 1999, 2001) have published a number of short communications but in none of these works taxonomic accounts have been included and the same is attempted here.

MATERIALS AND METHODS

The present work is based on collection made regularly during 1996-1999 by the author from several localities in different parts of the district. In the following enumeration of species, the arrangement of the families is broadly according to the system of Gradstein (1979), Kenrick *et* Crane (1997), Judd & *al.* (2002), Crandall-Stotler and Stotler (2000) and Buck *et* Goffinet (2000). In determining names of the taxa and other related aspects, reference has also been made to Gangulee (1971-1980), Bischler (1979), Conard (1979), Gradstein (1991), Hasegawa (1994) and Singh (1995, 1997). The specimens are deposited in BURD. Late Prof H. C. Gangulee, Dr. S. R. Gardstein, Prof. P. C. Wu and Dr. J. Hasegawa have identified a few specimens.

Analysis of the flora :

Approximately two-thirds of the total geographical area of Bardhaman district is occupied by the paddy fields (Bhattacharyya, 1986). Liverworts, hornworts and mosses grow freely in the moist paddy fields, orchards, embankments, dilapidated walls and on the tree trunks. Out of 26 species described in this paper 4 are epiphytes, 2 (Sun-loving- *Plagiochasma* and shade loving moss-*Gymnostomiella*) grow on the dilapidated walls and the rest are terrestrial. The epiphytic liverworts (*Archilejeunea* and *Lejeunea*) and the sciophytic mosses *Fissidens sylvaticus* and *Gymnostomiella vernicosa* are not found here in fertile stage. All these species and two other epiphytic mosses, *Erpodium mangiferae* and *Octoblepharum albidum*, pass an active growth phase only during wet season (June to October) and are in poikilohydric/anhydrobiotic perennation on the tree trunks or dilapidated walls during dry season (November to May). This adaptive strategy (i.e. annual alteration of active growth and development and perennation) confers to these species, the capacity to survive in ecological niches that are usually inhospitable to other land plants.

Erpodium mangiferae and few other epiphytic mosses produce green spores. These spores, in spite of being in spore sac of capsule, can synthesize chlorophyll and photosynthetically active chloroplast. These green spores are rather short lived

Archilejeunea planiuscula and *Lejeunea boninensis* are the new records for the Indian Union. In all probability, these epiphytic components of the flora are the outcome of long-distance dispersal brought by migratory birds. In wet costal vegetation, there is an increasing trend of diversity in favour of *Plasiochasma appendiculatum* and *Riccia billardieri*. Tropical moss, *Fissidens subpalmatus* is endemic to Purneah district (Bihar), Bombay and Rarh Bengal. Though the sporophytes of liverworts and the mosses provide diagnostic features, four species (*Archilejeunea planiuscula*, *Lejeunea boninensis*, *Fissidens sylvaticus*, and *Gymnostomiella vernicosa*) reproduce here asexually, and some of the bryophytes were identified by the specialists.

HEPATICAEE

ORDER 1: MARCHANTIALES

Key to the suborder

- | | |
|---|-------------------|
| 1a. Archigoniophore present | I. MARCHANTIINEAE |
| 1b. Archigoniophore absent | 2 |
| 2a. Gametophytes and sporophytes most elaborate | II. CORSINIINEAE |
| 2b. Gametophytes and sporophytes simplest | III. RICCIINEAE |

Suborder I : MARCHANTIINEAE

AYTONIACEAE

Plagiochasma appendiculatum Lehm. & Lindenb. in Lehmann, Nov. minus cogn. strip. pug. 4: 14. 1832; Kashyap, Liverworts of the Western Himalayas and the Punjab Plain pl. 16, fig. 4-7, 1929. (Fig. 1. a-k.)

Plant body thalloid, forming perennial, compact rosette. Male and female branches separate. Male receptacle sessile, horse-shoe shaped, surrounded by small scales. Archigoniophore short stalked containing 5-6 involucre. Spores yellowish, reticulate-lamellate 36-40 µm in diameter. Elaters smoothly thickened and variable in size. Fruiting time: December-February.

Habitat: Common on the dilapidated walls. Bhatta 218! Ichalabad; Bhatta 96! Bansbaria; Rarh 490! Barakar; Rarh 65! Asansol.

Distrib.: Tropical liverwort. India (almost throughout the country); Afghanistan, Pakistan, Socotra, Yemen, Ethiopia, Kenya, Rhodesia, Nepal, China, Formosa, Celebes, Philippines, and Vietnam.

Suborder II : CORSINIINEAE

CYATHODIACEAE

Cyathodium cavernarum Kunze Lehm., Pugillus 6 : 17. 1834; Srivastava & Dixit in J. Hattori Bot. Lab. 80: 149-215. 1996. (Fig. 2. a-i.)

Plant body thallose. Plants without gemmae formation. Archigonia in a bivalved involucre just under the apex. Involucre smooth, without any ciliate processes. Spores dark brown, spiny. Elaters reddish brown, trispiral, Operculum (the lid or apical disc) with the inner tier or 8 cells. Fruiting time: October.

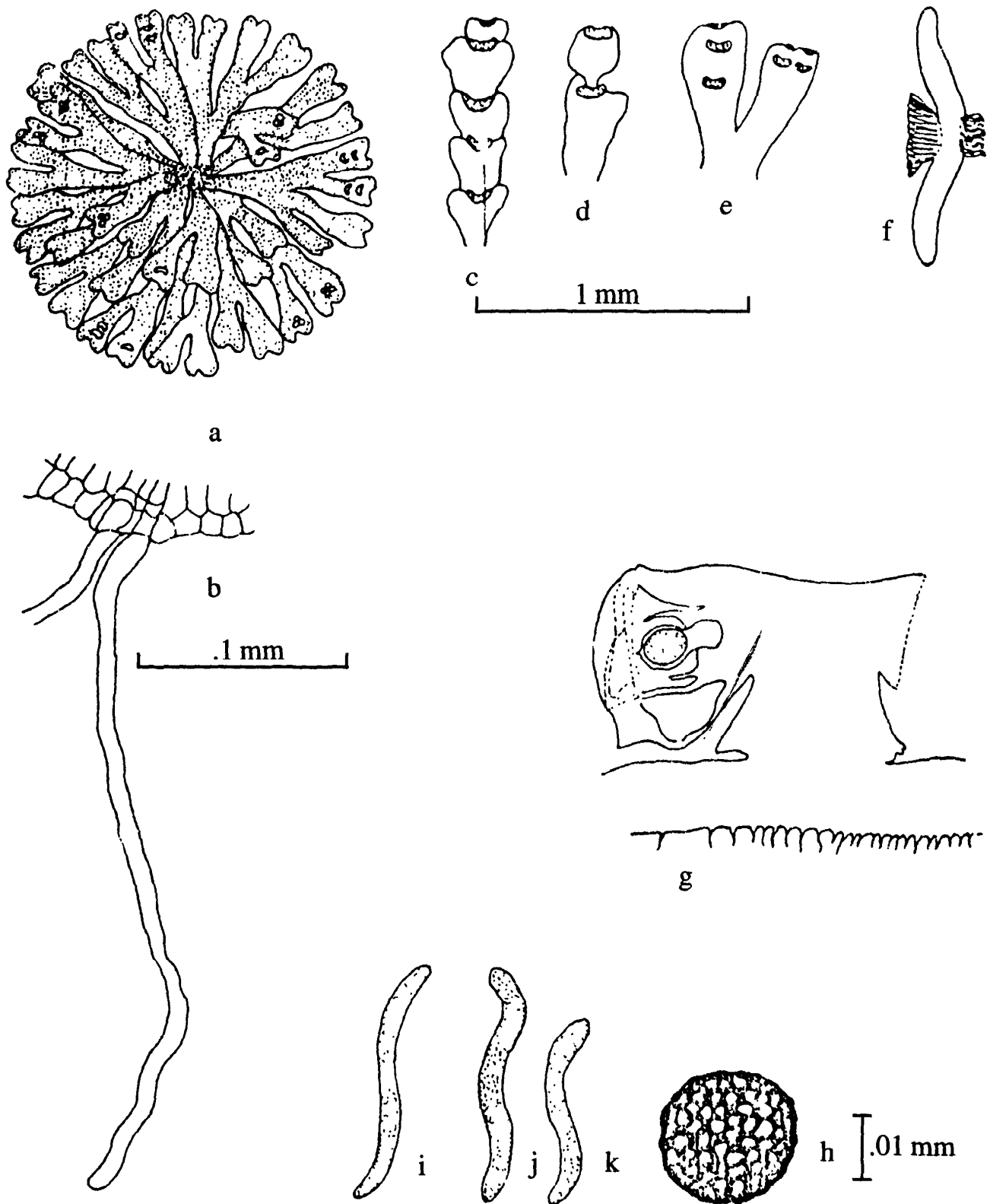


Fig.1. a-k: *Plagiochasma appendiculatum* Lehm. et Lindenb.: a. A typical rosette; b. Rhizoids; c-e. Male branches; f T. S. through male receptacle; g. Vertical longitudinal section through the carpocephala; h. Spore; i-k. Elaters.

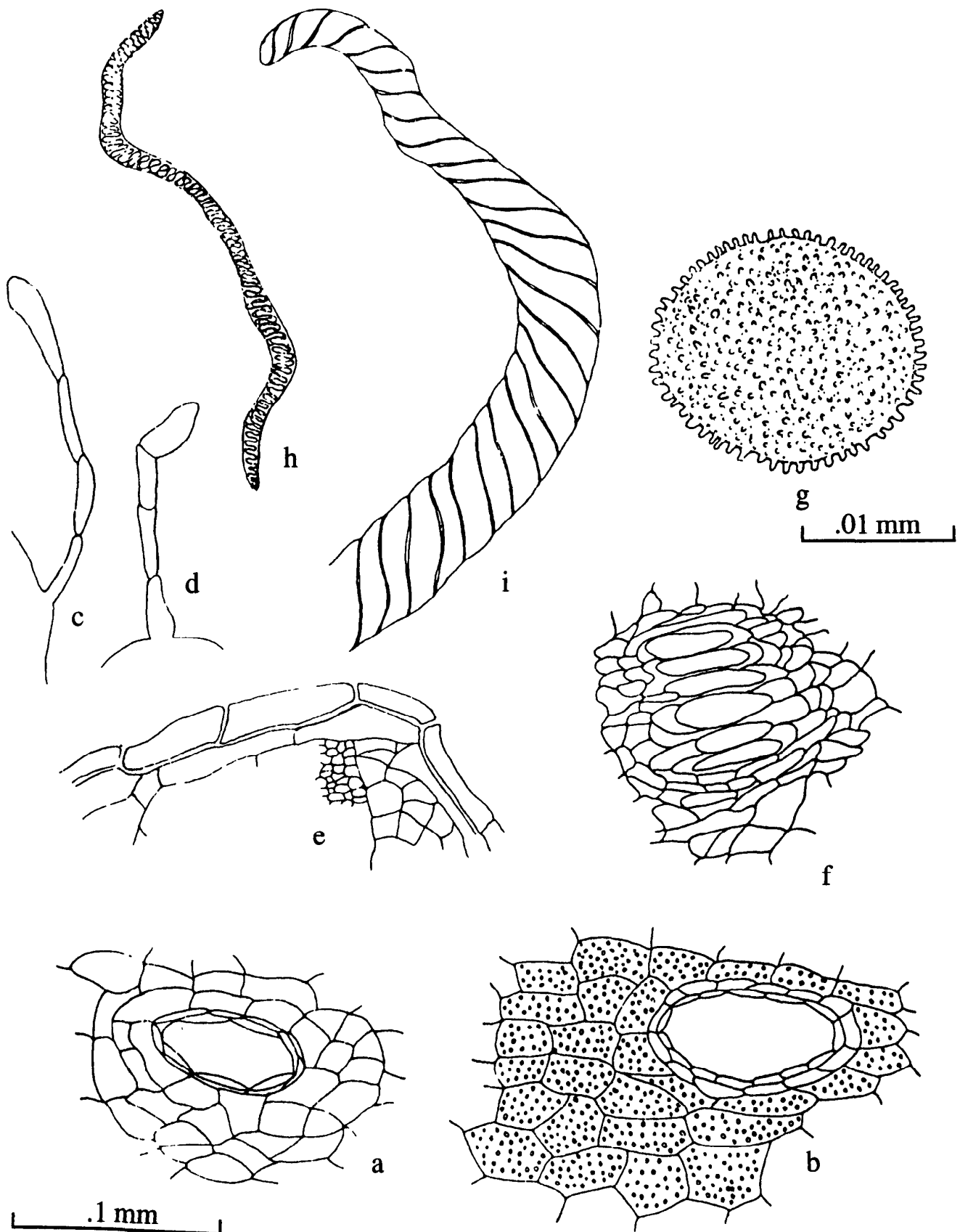


Fig. 2. a-i: *Cyathodium cavernarum* Kunze: a. Dorsal pore; b. Ventral pore; c-e. Ventral scales; f Section of an antheridial receptacle; g. Spore; h-i. Elaters.

Habitat : Common in the moist shaded areas. Bhatta. 230! Chottabelun; Rarh 402! Goda; Rarh 522! Kalna; 532! Durgapur; Rarh 612! Burdwan; Kaustuv 109! Durgapur.

Distrib. : India (almost throughout the country). Myanmar, Indonesia, Africa, and America. A pantropical liverwort.

Suborder III : RICCIINEAE

RICCIACEAE

Riccia L. *nom. cons.*

Key to the species

- | | |
|--|-----------------------|
| 1a. Thallus monoecious, 2-many times dichotomously branched | 2 |
| 1b. Thallus dioecious, 1-2 times dichotomously branched; air spaces in many layers, spongy; male smaller than female | <i>R. frostii</i> |
| 2a. Thallus with incomplete rosettes; apical tubers present; spores dark brown | <i>R. billardieri</i> |
| 2b. Thallus with complete rosettes; apical tubers absent; spores brown | 3 |
| 3a. Thallus many times dichotomously branched, pitted; spores reticulate but reticulation in complete | <i>R. crystallina</i> |
| 3b. Thallus 2-3 times dichotomously branched, not pitted; spores reticulate but reticulation complete | <i>R. gangetica</i> |

Riccia billardieri Mont. *et* Nees, Syn. Hep.: 602. 1844-1847; Udar in J. Indian Bot. Soc. 36:46-50. 1957; Srivastava in Bull. Nat. Bot. Gards. 104: 27-29. 1964, *Riccia bulbifera* St., Sp. Hep. 1 : 24. 1889. *Riccia bengalensis* Khan in The Bryologist 60 : 28. 1957. *Riccia pimodii* Kachroo in J. Indian Bot. Soc. 38(2) : 213-220. 1959. (Fig. 3. a-j.)

Monoecious, plants forming incomplete rosettes, margins bluish purple; sporogonia few along the median sulcus, number of spores within a sac > 125, spores dark brown, 72-92 μ m in diameter, reticulate, corners of the reticulations projected. Fruiting time : August - October.

Habitat: Common on garden soil. Rarh 400! Talit 501! Kanchannagore, 580! Goda, 600! Golapbag.

Distrib.: India : Rarh Bengal, Darjeeling,. Lucknow, Guwahati, Rajasthan, S. India.

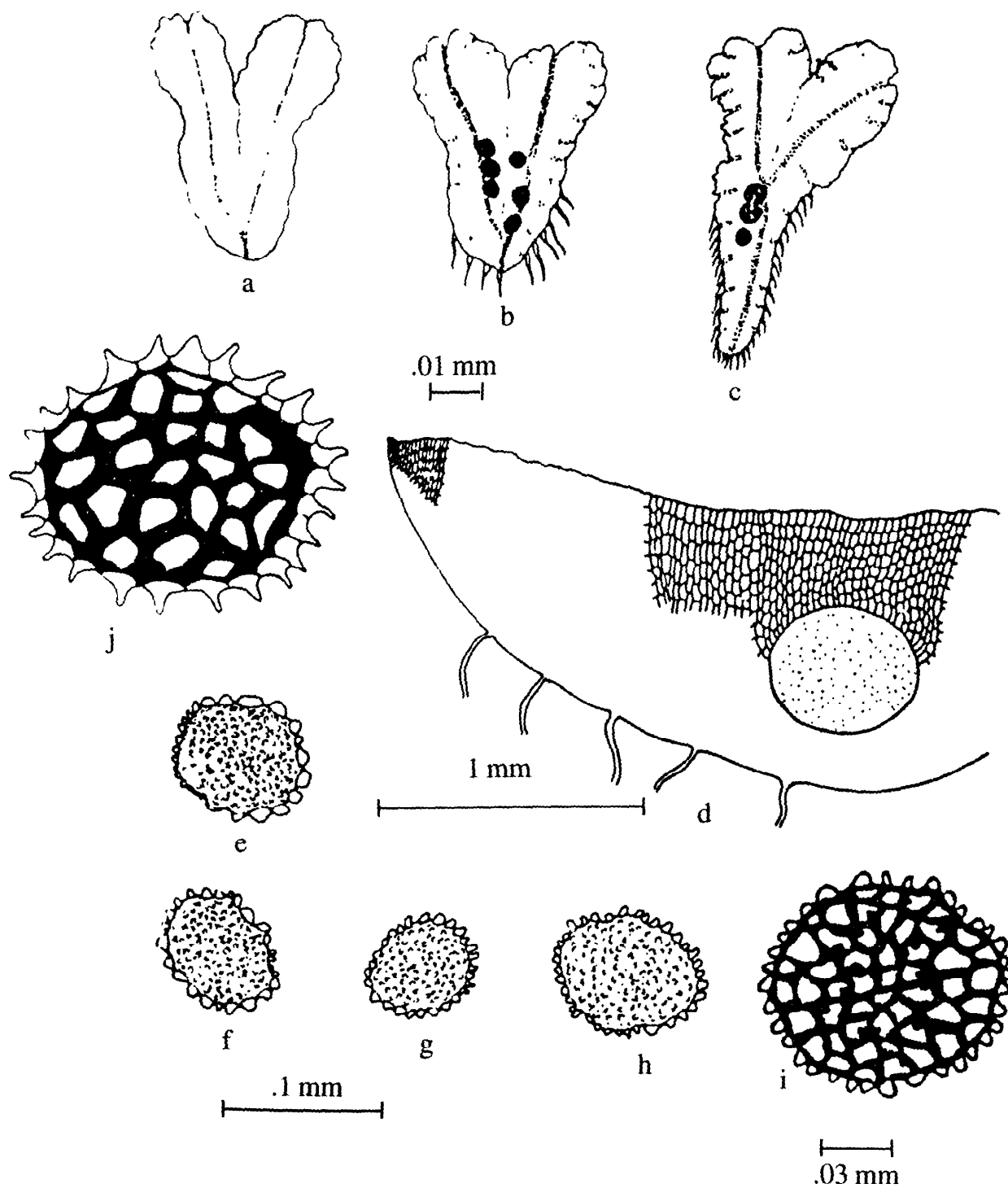


Fig. 3. a-j : *Riccia billardieri* Mont. & Nees: a. Thallus (dorsal view); b & c. Thallus (ventral view); d. T. S. of thallus; e-j. Spores.

Riccia crystallina L. Sp. Pl.: 1138, 1753; Srivastava in Bull. Nat. Bot. Gards. 104: 47-49. 1964. *Riccia robusta* Kash. in J. Bomaby nat. Hist.Soc. 24: 348. 1916.

Monoecious; plants forming complete rosettes, thalli spongy, several times dichotomously branched, pitted (visible to the naked eyes); sporogonia numerous; spore tetrahedral, brown, 72-84 μm in diameter, irregularly reticulate, reticulation incomplete. Fruiting time: September-October.

Habitat: Common along the margins of paddy fields. Rarh 496! Goda, 676! Burdwan.

Distrib.: India: Indo-Gangetic plain, Himalayas, Mount Abu, Central and South India.

Riccia frostii Aust. in Torrey Bot. Club 6 : 17. 1875; Srivastava in Bull. Nat Bot. Gards 104: 51-53. 1964. (Fig. 4 a-g.)

Plants forming complete rosettes; thalli 1-2 times dichotomously branched; male plants small, female plants large; rhizoids simple; tuberculate rhizoids absent; sporogonium globular, number of spores 200-210/sac; spores tetrahedral, dark brown, 50-60 μm in diameter; outer face with wavy ridges. Fruiting time: November-December.

Habitat: Common on riverside alluvial soil. Bhatta. 1190! Chottobelun; Rarh 495! Kalna, 675! Golapbag.

Distrib.: India: Rarh Bengal, W. Himalayas, E. Himalayas, Assam, Indo-Gangetic plain, S. India. Canada and USA.

Riccia gangetica Ahmad in Curr. Sci. 11: 433. 1942; Srivastava, in Bull, Nat. Bot. Gards. 104 : 35-37. 1964. (Fig. 4. a'-g'.)

Monoecious, thalli forming complete rosettes, bluish green, sporogonia in 2-4 rows; number of spores 86-90/sac; spores reddish brown, 81-108 μm in diameter, reticulate. Fruiting time: August-October.

Habitat: Common on soils at the margins of paddy fields. Bhatta. 219! Chottabelun; Rarh 502! Kanchannagore, 585! Golapbag.

Distrib.: India : Rarh Bengal, Gangetic valley, Garhwal, Aravallis, Panhmari, Nilgiri.

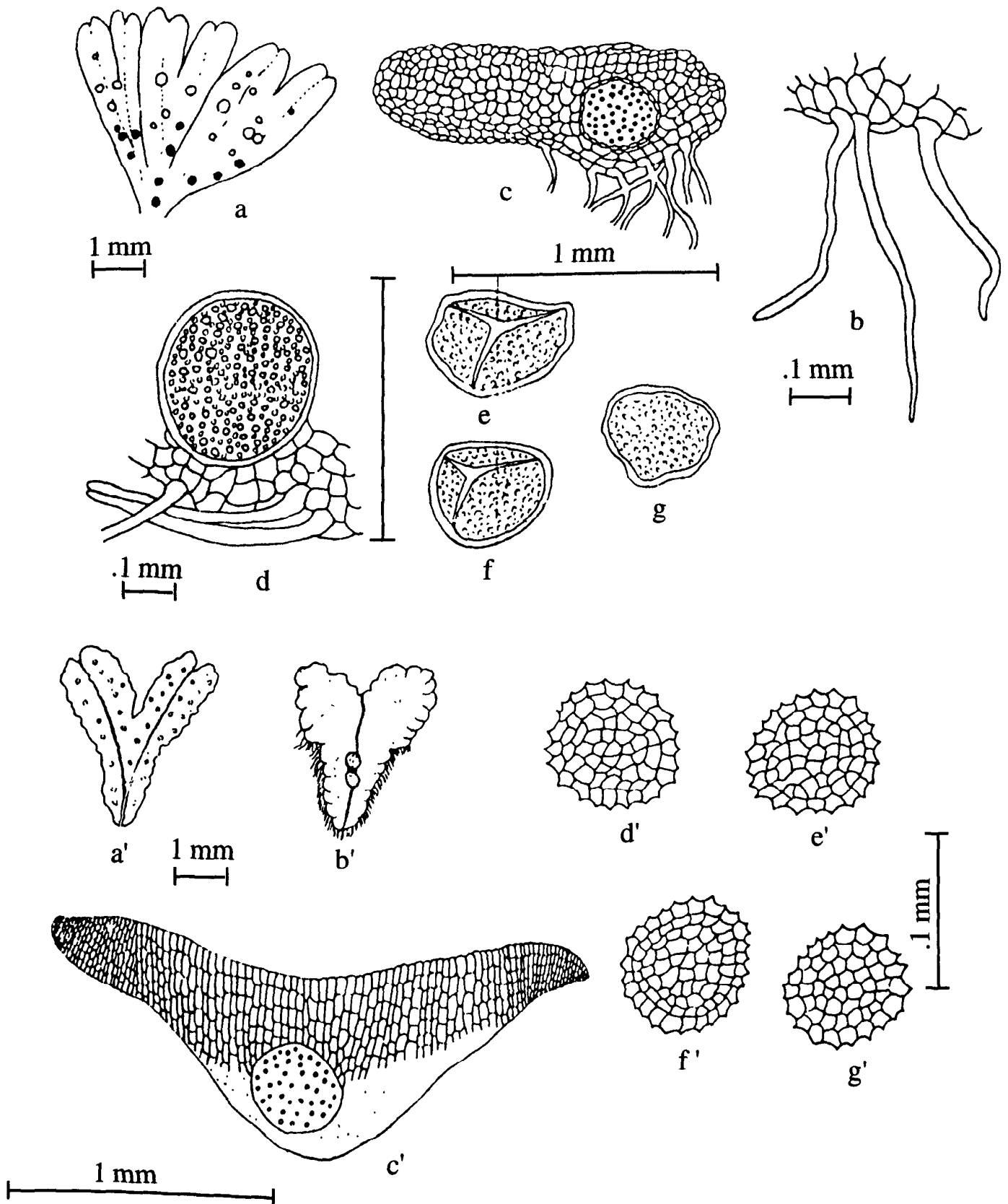


Fig. 4. a-g.: *Riccia frostii* Aust.: a. Thallus (ventral view); b. Rhizoid; c & d. T. S. of female thallus; e-g. Spores. a'-g': *Riccia gangetica* Ahmad.; a'. Thallus (dorsal view); b'. Thallus (ventral view); c'. T. S. of thallus; d'-g'. Spores.

ORDER -2 : JUNGERMANNIALES

LEJEUNEACEAE

Key to the subfamily

- 1a. Mature plants closely appressed to substrate; amphigastria bifid I. Lejeuneoideae
 1b. Plant delicate, lack secondary pigmentation, amphigastria entire II. Ptychanyhoideae

Subfamily - I : PTYCHANYHOIDEAE

Archilejeunea planiuscula (Mitt.) Steph. Spec. Hep. 4: 731-1911; Gradstein Trop. Bryol. 4(1): 4,9,1991.
Archilejeunea mariana auct. Verdoorn in Ann. Bryol. 4: 40-192. 1934; non (Gott.) Steph.
 (Fig. 5 a-f.)

Plant body leafy, 1.4 cm long. Stem with about 14 cortical cells and 16 medullary cells; the dorsal cortical cells-not larger than the medullary cells; ventral merophyte- about 4 cells wide. Leaves widely spreading flat or involuted under dry condition; cells isodiametric with simple triangular trigones; oil bodies segmented, 12-24 in each cell. Amphigastria round without any notch. Not found fruiting.

Habitat: Common epiphytic, perennial liverworts. A new record to the known bryoflora of the Indian Union. Rarh 403! Golapbag; 613! Durgapore. [det. S.R. Gradstein].

Distrib.: Indo-Pacific region.

Subfamily-II : LEJEUNEOIDEAE

Lejeunea boninensis Horikawa in J. Sci. Hiroshima Univ. Ser. B., div. 2.: 24, f 7., 1931. M. Mizutani, J. Hattori Bot. Lab. 24 : 200, 209-210, 1961. (Fig. 6. a-f.)

Plant small, yellowish-green, leafy; usually 15 mm long, 0.1 mm wide; stems prostrate, 0.05 mm in diameter, with leaves 0.7 -0.8 mm wide, sparsely branched; cross-section of the stem about 5-6 cells wide, cortical cells 7, larger than the medullary cells, medullary cells about 10, thin walled; leaves imbricate, widely spreading and flat; leaf-lobe, ovate, 0.4-0.5 mm long and wide, apex rounded, margins entire, apical cells 10-12 × 8-10 µm, median cells 15-25 × 13-17 µm, walls thin but with large, trigones, basal cells 23-25 × 18-22 µm, leaf-lobule small, inflated, about 1/3 the length of leaf-lobe, triangular, the free margin straight; amphigastria sparse, distinct, small, 1.5-2 times as wide as the stem, erect-spreading, ovate, ca 0.2 mm long, ca 0.15 mm wide, 1/2-bilobed, lobes triangular, with acute apices, sinus acute, lateral margins entire, the line of insertion cuneate. Not found fruiting.

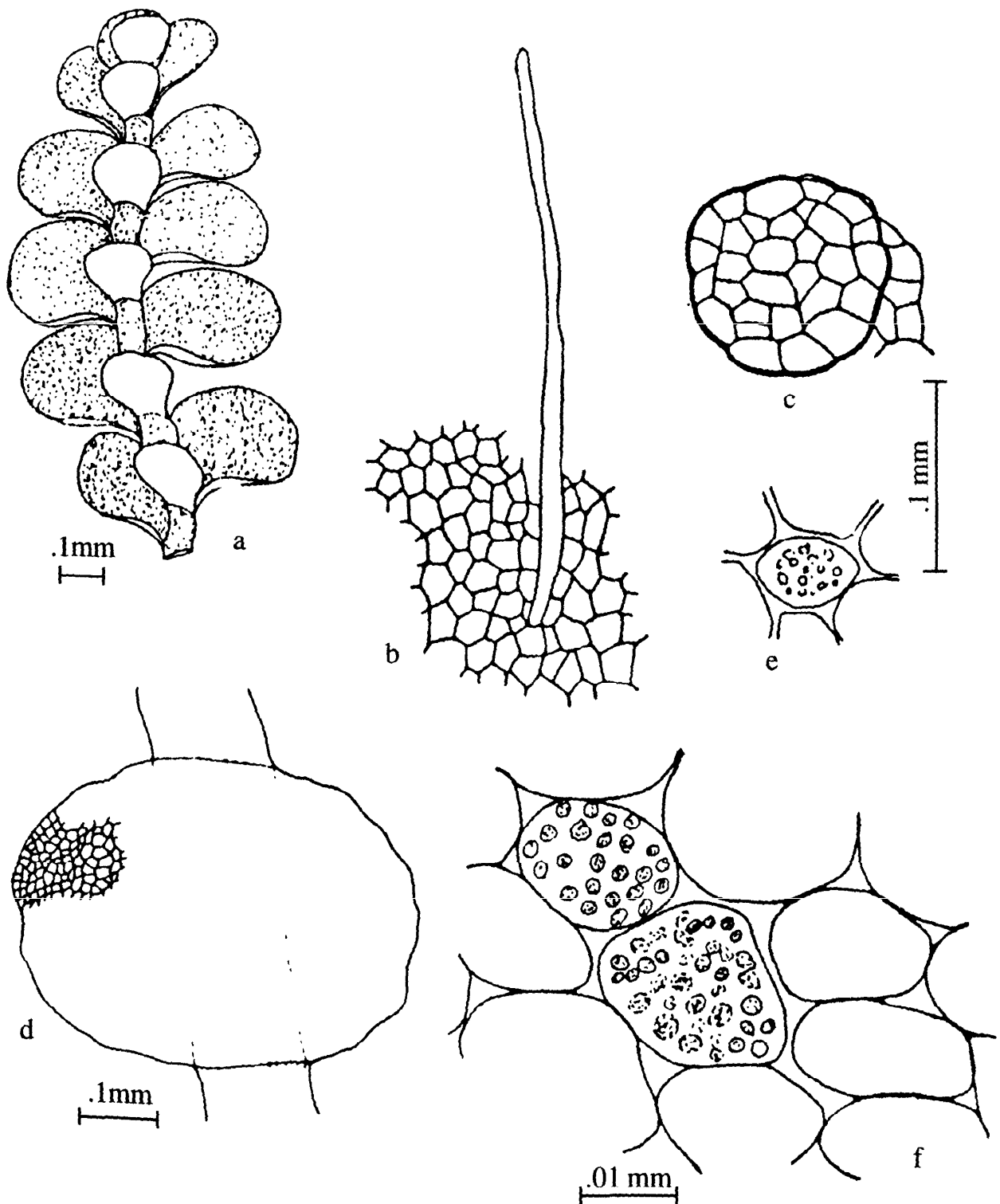


Fig. 5.a-f: *Archilejeunea planiuscula* (Mitt.) Steph.: a. A portion of the vegetative branch; b. Rhizoid; c. Cross section of the stem; d. Amphigastria; e. Leaf cell wall thin and with small triangle; f. Leaf cells.

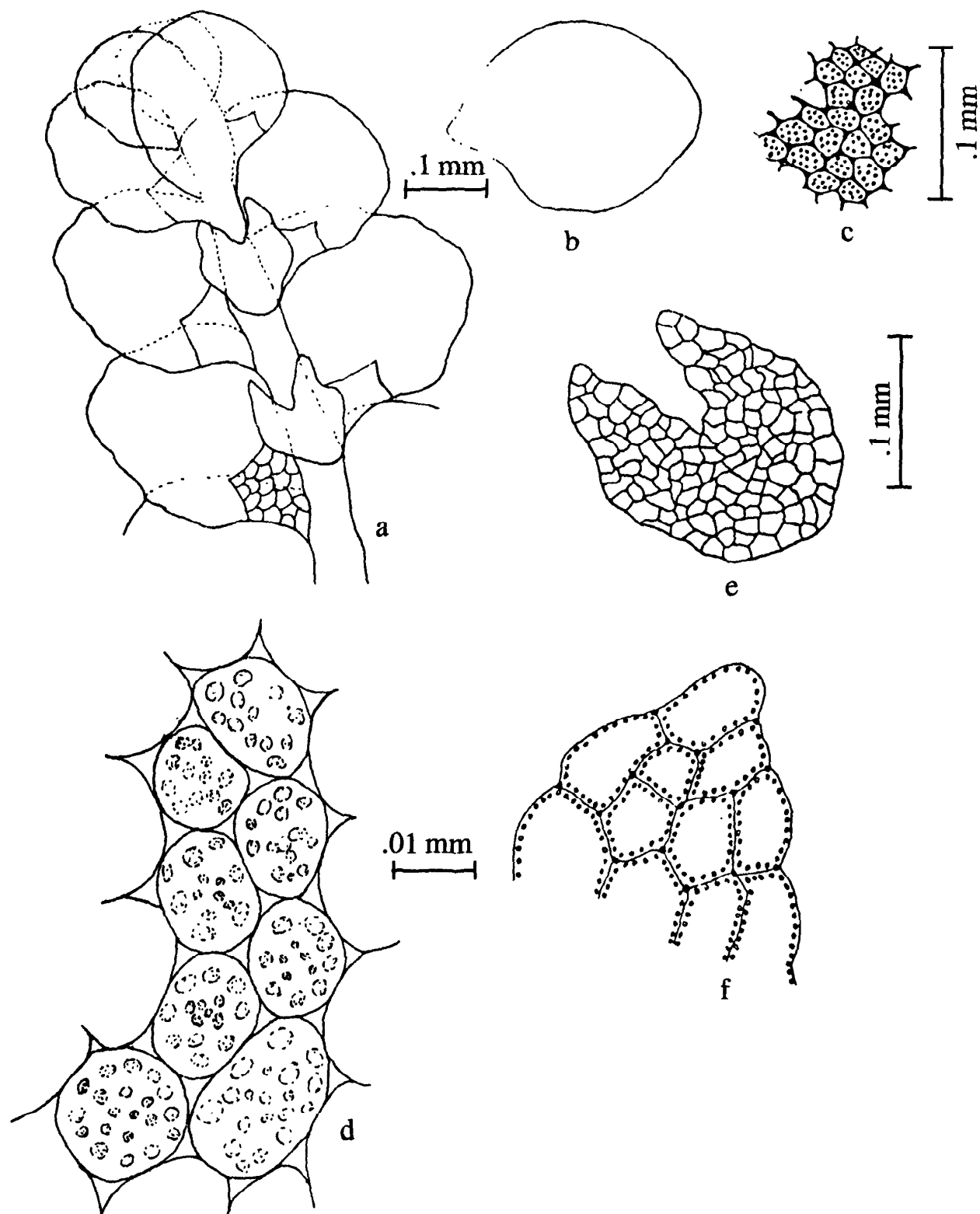


Fig. 6. a-f: *Lejeunea boninensis* Horik.: a. A part of a plant (ventral view); b. Single leaf; c. Base portion of leaf cells showing chloroplast arrangement; d. Leaf cells showing oil globules; e. Amphigastria; f. Apical cells of amphigastria.

Habitat: Common epiphytic, perennial liverworts on bark of evergreen trees in lowland area at Golapbag and Romna forest. Resemble *Lejeunea flava* (Sw.) Nees, but underleaves distant, deeply bilobed with narrow lobes and a wider sinus. A new record to the known bryoflora of the Indian Union. Rarh 404! Golapbag; 624! Asansol. [det. P.-C. Wu].

Distrib.: India: Rarh Bengal; Japan (Bonin Island and Kinki District-Central Japan).

ANTHOCEROTAE

NOTOTHYLADACEAE

Notothylas indica Kashyap in Proc. Lahore Phill. Soc. 4: 49-56. 1925; Asthana & Srivastava, Bryophyt. Biblioth. 42: 94-96. 1991; Singh in Kumar, Recent Studies in Indian Bryophytes, 1995.

(Fig. 7. a-m.)

Monoecious, light green, dorsally ridged towards their anterior portion that gives the plant a 'fluffy' appearance. Involucres plicae at their apices; capsules usually bivalved with the margin of each valve lined by 2 rows of deeply pigmented, thick walled special cells; capsule dehiscing longitudinally by two sutures; columella present; surface cells of the columella with spiral thickening; epidermal cells of the capsule deep brown with conspicuously stratified thickenings at their transverse and radial walls; spores deep brown; triradial mark continuous with the equatorial girdle; $29.1-33.3 \times 33.3-41.6 \mu\text{m}$; pseudoelaters 2-3 celled, subglobose, light yellow in colour with transverse/spiral thickening bands. Fruiting time: July- November.

Habitat: Common on moist garden soil and concrete floor. Rarh 523! Golapbag, 614! Goda; Bhatta. & Ban., 3773! (Miyazaki University S. E. Japan). [det. J. Hasegawa].

Distrib.: India (Allahabad, Bombay, Nagpur, Rarh Bengal, Kolkata, Lucknow, Mussoorie, Dehradun); Myanmar, Pakistan.

ANTHOCEROTACEAE

Anthoceros crispulus (Mont.) Douin in Rev. Bryol. 32: 25. 1905; Asthana & Srivastava, Bryophyt. Biblioth. 42: 30-33. 1991; *A. punctatus* var. *crispulus* Mont. in Webber *et* Berthelot, Hist. Ins. Can. Bot. 2(4): 64. 1840.

(Fig. 8. a-j.)

Monoecious. Plant body dark green, spongy, crispate; chloroplasts single with spherical pyrenoid. Involucres smooth. Capsules long, linear, dorsal; epidermal layer of capsule wall stomatiferous, with 3-7 stomata / sq mm; spores dark brown, $46-54 \mu\text{m}$ in diameter, sporoderm reticulate (prominent in proximal view), triradial rays reaching the periphery usually in contact with the sculpturing. Pseudoelaters 3-6 celled. Fruiting time: November- February.

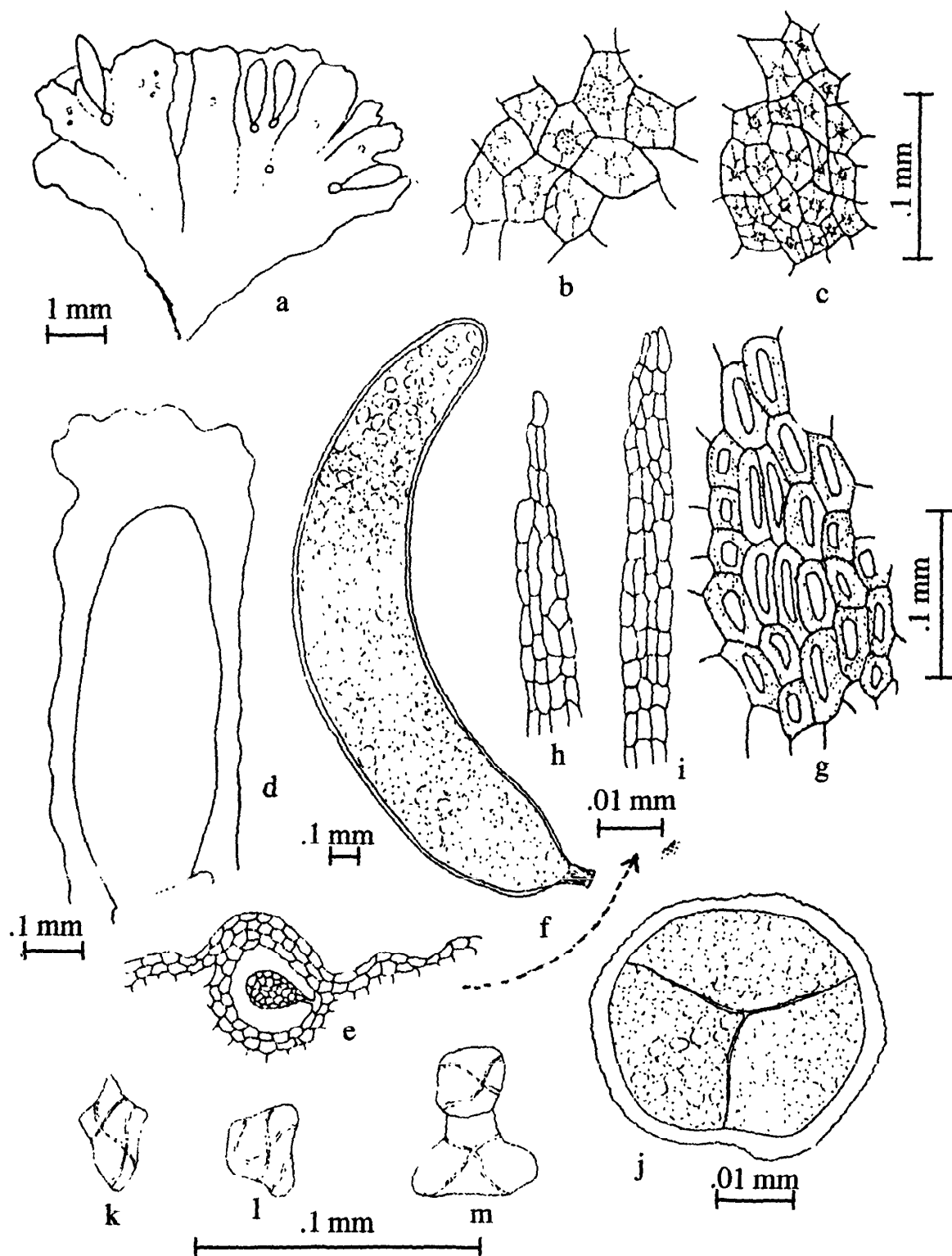


Fig. 7. a-m.: *Notothylas indica* Kashyap: a. Thallus; b,c. Chloroplasts in upper epidermal layer of thallus; d. Apical portion of involucre; e. T. S. of thallus showing antheridia (orange in colour); f. Capsule; g. Epidermal layer of capsule wall; h,i. Apical portion of columella; j. Spore; k-m. Pseudoelaters.

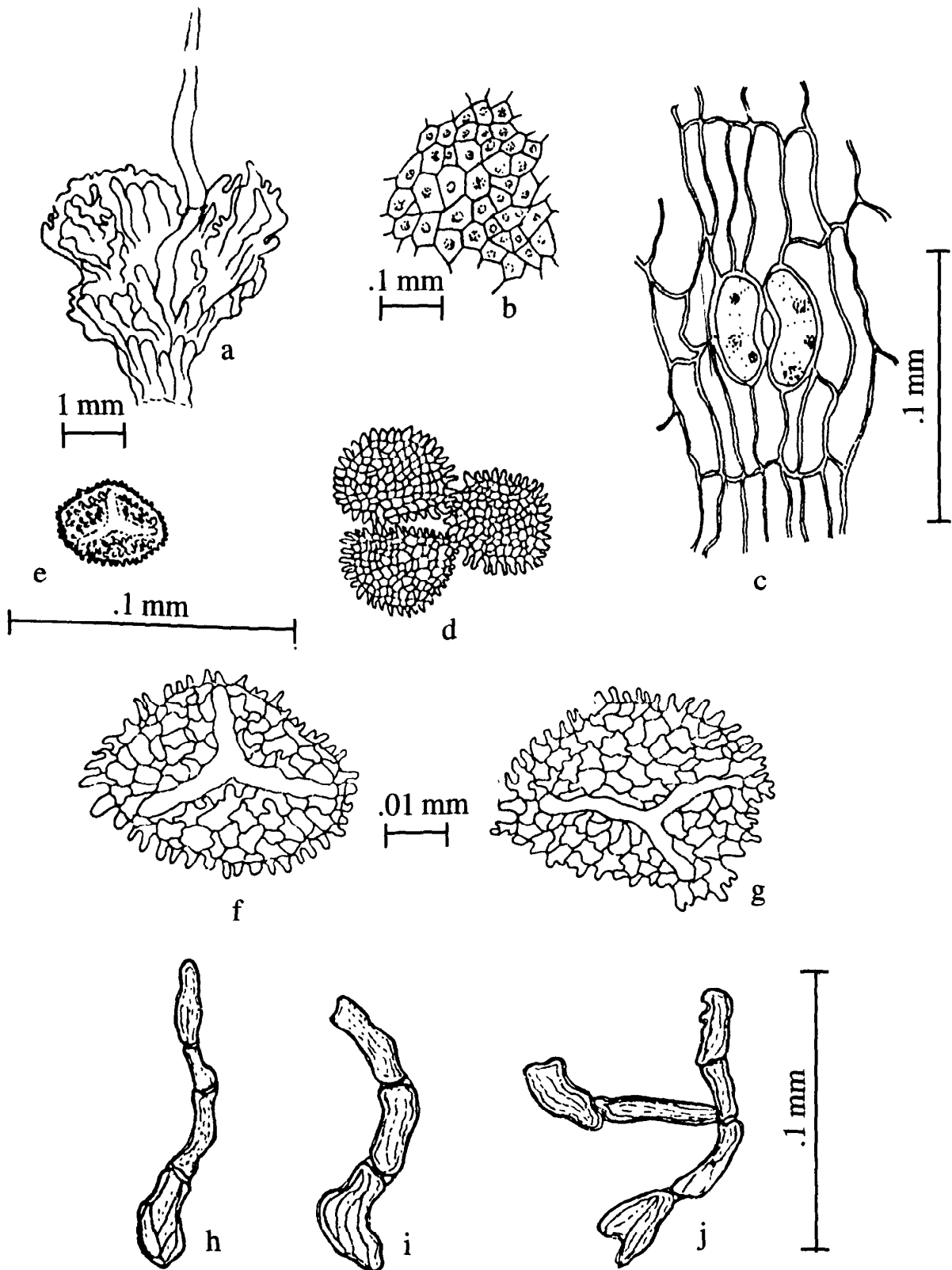


Fig.8. a-j.: *Anthoceros crispulus* (Mont.) Douin.; a. Gametophyte with sporophyte; b. Chloroplast bearing cells; c. Epidermal layer of capsule wall showing stomata; d. Spore & (distal view); e-g. Spores (proximal view); h-j. Pseudolaters.

Habitat: Rare at the moist margins of potato fields. Bhatta. 95 ! Chottabelun, P.S. Burdwan.

Distrib.: India: Nainital, Khandala, Pratapgarh, Kodaikanal, Ooty, Travancore, Giridi, Rarh Bengal; Europe and U.S.A. Wide spread in the Northern Hemisphere.

MUSCI

ORDER-1: FUNARIALES

FUNARIACEAE

Key to the genus

- | | |
|---|----------------------|
| 1a. Peristome lacking cilia, opposite; costa well developed | <i>Physcomitrium</i> |
| 1b. Peristome teeth absent | <i>Entosthodon</i> |

Physcomitrium (Bird.) Bird.

Key to the species

- | | |
|--|------------------------|
| 1a. Plant body leafy; leaves broad, seta long exserting the capsule | 2 |
| 1b. Plant body leafy; leaves narrow, seta short, not exerting the capsule | <i>P. indicum</i> |
| 2a. Leaves oblong- obovate, operculum apiculate, lid like | <i>P. cyathicarpum</i> |
| 2b. Leaves obovate lanceolate to oblong- lanceolate;
operculum as wide as capsule top | <i>P. eurystomum</i> |

Physcomitrium cyathicarpum Mitt. in J. Linn. Soc. Bot. Suppl. 54, 1859; Gangulee, Mosses of Eastern India, etc. 4: 839-840. 1974. (Figs. 9. a'-e' & 10)

Plants small, sturdy. Upper leaves clustered, erect-spreading, oblong-obovate; costa strong, percurrent in upper leaves, often end below apex in lower small leaves. Calyptra not lobed. Seta short, slender, not exserting the capsule. Capsule globose; operculum apiculate; spores round or flattened, bright red brown. Fruiting time: November-December.

Habitat : Common, tiny, sessile moss, on the shaded moist galls at the river bed. Bhatta. 473! Chottabelun [det. H. C. Gangulee]; Rarh 48! Kanchannagore; 607! Karjona.

Distrib.: Northern India: Ranikhet, Rajasthan, Rarh Bengal, Gangetic South Bengal, Bihar, Punjab, Delhi, Uttar Pradesh; East Nepal.

Physcomitrium eurystomum Sendtn, in Denkschr. Bayer Bot. Ges. Regen. 3: 142. 1841; Gangulee, Mosses of Eastern India, etc., 4: 844-845. 1974. *Physcomitrium acuminatum* B.S.G. in Bryol. Eur., 3: 247. 1841. (Figs. 9. a-h)

Plants small to medium. Upper leaves clustered, erecto-patent to spreading, shrunk when dry, ovate-lanceolate to oblong-lanceolate. Seta slender, 3-9 mm long. Capsule short with a distinct apophysis; operculum as wide as capsule, spores globose, deep brown. Fruiting time: July-November.

Habitat: On moist bank of the Damodar. Rarh 505! Kanchannagore; 611, Ichlabad.

Distrib.: India: Rarh Bengal, South Bengal, Kumaon; North Vietnam, Taiwan, China, Japan, Great Britain, France, Central & South Africa.

Physcomitrium indicum (Dix.) Gangulee, in Bull. Bot. Soc. Bengal 23: 131. 1969.

Physcomitrellopsis indica (Dix.) Gupta in J. Indian Bot. Soc., 12: 122. 1933.

Plants small, bright green, stem short. Leaves lax; upper leaves erecto-patent, lanceolate from an obovate base; lower leaves with nerve vanishing well below apex. Calyptra 2-4 lobed. Seta short, not exerting the capsule, operculum present; capsule globose; spores globose brown. Fruiting time: July-February.

Habitat: On moist alluvial soil. Rarh 479! Kanchannagore, 595! Goda.

Distrib.: A Gangetic plain species: Varanasi, Rarh Bengal, Gangetic South Bengal.

Entosthodon Schwaegr.

Entosthodon nutans Mitt. in J. Linn. Soc. Bot. Suppl. 1: 55. 1859; Gangulee, Mosses of Eastern India, etc. 4: 850-851. 1974.

Plants small, green, forming dense patches. Laminal cells rhomboid or narrow; costa thin but clear. Seta short; capsule exerted, usually erect; apophyses prominent; peristome teeth absent; operculum low, convex, without any apiculus; spores globose, opaque, finely papillose. Fruiting time: November-February.

Habitat: On damp shaded rice field. Bhatta. 475 ! Chottabelun; Rarh 480! Goda; 605! Talit.

Distrib.: India: Rarh Bengal, Gangetic West Bengal, Chottonagpur, Punjab, Joypur, U.P., Khandala; Pakistan (Lahore), Sudan. An Indo-African species.

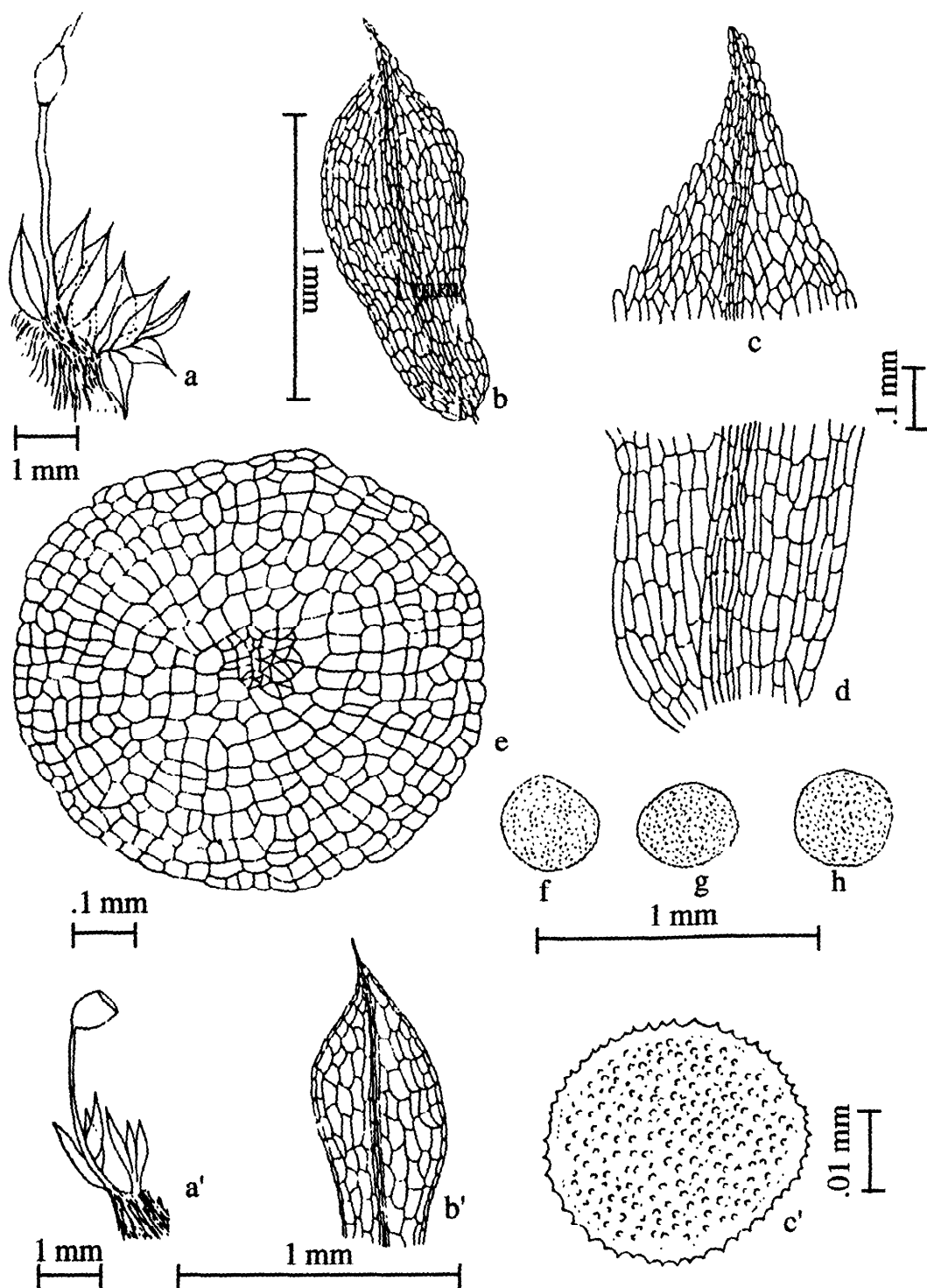


Fig. 9.a-h.: *Physcomitrium eurystomum* Sendtn.: a. Plant body; b. Leaf; c. Leaf apex; d. Leaf base; e. Operculum; f-h. Spores.

a'-c': *Physcomitrium cyathicarpum* Mitt.: a'. Plant body; b'. Leaf; c'. Spore.

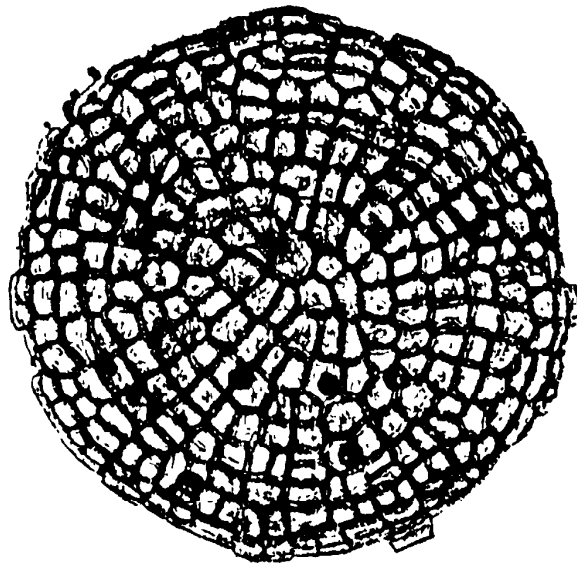


Fig.10.: *Physcomitrium cyathicarpum* Mitt.: Operculum ($\times 70$).

ORDER-2: DICRANALES

Key to the family

- 1a. Plants acrocarpous; leaves distichous with vaginant lamellae; costa prominent; peristome segments trabiculate; calyptrae cucullate Fissidentaceae
- 1b. Plants cladocarpous; leaves in three or more rows, without any vaginant lamellae; costa lacking; peristome absent; calyptrae mitrate Erpodiaceae

FISSIDENTACEAE

Fissidens Hedw.

Key to the species

- 1a. Plant body large, usually 1.5-2 cm long, with 15-25 pairs of leaves *F. sylvaticus* var. *sylvaticus*
- 1b. Plant body small, up to 0.5 cm long, with 14-16 pairs of leaves 2
- 2a. Leaf costa vanishing much below the tip *F. splachnobryoides*
- 2b. Leaf costa almost reaching the tip, leaf narrowly acuminate *F. subpalmatus*

Fissidens sylvaticus Griff. in Calcutta J. Nat. Hist., 2: 507. 1842, var. **sylvaticus**; Norkett, in Gangulee's Mosses of Eastern India, etc. 2: 450, 457, 535, 536. 1971; *Fissidens sylvaticus* var. *teraiicola* (C. Muell.) Gangulee, Mosses of Eastern India, etc. 2: 539-540. 1971. *Fissidens teraiicola* C. Muell. in Linnaea, 37: 164. 1872.

Plants small, gregarious, 0.8 to 1.5 cm long, and up to 3 mm wide with yellowish green leaves. Leaves usually 15-25 pairs, closely arranged on a shoot (about 2-3 leaves per mm of stem on young shoots). Protuberance (5-6 turgid cells on stem) glandular, jutting out from the stem and flattened on outside or rounded; size of glands variable, *ca* 80 × 40 µm. Leaves broad, oblong-ligulate, without limbidium and with broadly acuminate tip. Leaf margin usually denticulate by projection of cells. Costa prominent, ended in a short excurrent mucronate tip. Dorsal lamina base rounded, meeting nerve base at leaf attachment. Fruiting not known.

Habitat : Common on moist garden soil in the rainy season. Rarh 532! Golapbag, 640! Goda.

Distrib. : India : Western Himalayas, South India, Bihar, Chhotanagpur, Rarh Bengal, North Bengal, South Bengal & Nicobar Islands; Sri Lanka, Thailand, Philippines, Central Africa, Madagascar, New Zealand. Wide spread in Paleotropics up to the frost line. A geographical counterpart, *Fissidens taxifolius*, thrives above the frost line.

Fissidens splachnobryoides Broth. in Schum & Lanterb., Fl. Deutsch.Schutz. Suedsee 81.1900; Gangulee, Mosses of Eastern India, etc. 2: 462-464. 1971. Tan & Iwatsuki in J. Hattori Bot Lab. 74 : 350. 1993. (Fig. 11. a-f.)

Plants gregarious on patches of loamy or sandy soil. Shoot up to 1 cm long, 3 mm broad with leaves. Leaves distichous, oblong-lanceolate, narrower in basal part than in apical part, costa yellow-brown, ending far below tip, cells transparent, thin walled; those towards the base of the sheathing lamini more elongated.

Habitat : Common on soil and base of palm trees. Rarh 401! Goda; 601! Ichalabad.

Distrib. : India : Rarh Bengal, Kolkata, Western Ghats; Indonesia, New Guinea. An Indomalasian element.

Fissidens subpalmatus C. Muell. in Linnaea 37: 164. 1872; Gangulee, in Bull. Bot. Soc. Bengal 11(2): 65.1957. (Fig. 11. g.)

Plants small, green gregarious on shaded earth banks of ponds and gullies. Stems 2.5 to 4 mm long with 14-16 pairs of leaves. Leaves curled and somewhat contorted when dry; oblong ligulate, narrowly acuminate, sheathing lamini equal; cells smooth, transparent, rounded-hexagonal. Fruiting time: November to February.

Habitat : Gregarious tiny green mosses on shaded dried up ponds and gullies. Rarh 504! Berh.

Distrib. : Endemic tropical moss. India: Rarh Bengal, Purneah, and Bombay.

ERPODIACEAE

Erpodium mangiferae C. Muell. in Linnaea, 37: 178. 1872; Chopra, Taxonomy of Indian Mosses, 264-265. 1975; Gangulee, Mosses of Eastern India, etc. 5: 1136-1140. 1976. Tan & Iwatsuki in J. Hattori Bot. Lab 74.348.1993. *Aulacopilum luzonense* Bartram in Philippines J. Sci. 68 (1-4): 169, 209.1939; Chopra, Taxonomy of Indian Mosses, 264-266. 1975. *Syn. nov.* (Fig. 12. a-h.)

Plants delicate, corticolous, in loose tufts, pale green. Stem slender, elongate, creeping (up to 2 cm or more long), densely leaved; creeping main stem often destroyed later. Secondary branches (in fruiting stage) orthotropous: up to 1.86 mm long and 0.8 mm wide with leaves. Leaves all alike, symmetrical, spreading, concave, ovate, short acuminate, (up to 0.55 mm long and 0.37 mm wide at middle); margins entire, and flat; costa lacking. Laminal cells smooth, upper cells isodiametric or elongate; cells at all region rhomboid (+ $18 \times 18 \mu\text{m}$). Seta very small, hardly 0.2 mm, straight, yellowish green. Capsule erect, oblong, immersed, urn-shaped (+ 0.71 mm long and +0.38 mm in diameter at top). Annulus broad, long persistent. Peristome absent. Operculum small (+0.23 mm in diameter at base), nearly convex, rostrate (+ 150 μm long and + 75 μm in diameter at base). Calyptrae fugacious, mitrate, slightly dentate at the base, covering only the operculum. Spores large (30 μm to 40 μm in diameter), green, globose, papillose, *ca* 190 spores per capsule. Fruiting time: July-September.

Habitat: Epiphytic, perennial, slender mosses upon the exotic, tropical American rain trees. Rarh 478! & 590! Golapbag; Kaustuv 104! Golapbag; Kaustuv 108! Durgapur.

Distrib.: India : Rarh Bengal, Orissa, Bihar (Ranchi), Assam, north Western Himalayas, Uttar Pradesh (Saharanpur), Western Ghats, Andhra Pradesh; Philippines. An Idomalesian species.

ORDER-3: POTTIALES

Key to the family

- 1a. Plants terrestrial; cauline central strand often present; leaves narrowly lanceolate to ligulate; laminal cells typically papillose; peristome of 16 or 32 segments, typically papillose Pottiaceae
- 1b. Plants epiphytic; stem lacking central strand; leaves narrowly to broadly lanceolate; laminal cells smooth and with hyaline cancellinae on either side of costa at leaf base; peristome fused into 8 segments, smooth, vertically striate Calymperaceae

POTTIACEAE Schimp. *nom. cons.**Key to the genus*

- 1a. Plants tiny, very soft; costa very feeble

Gymnostomiella

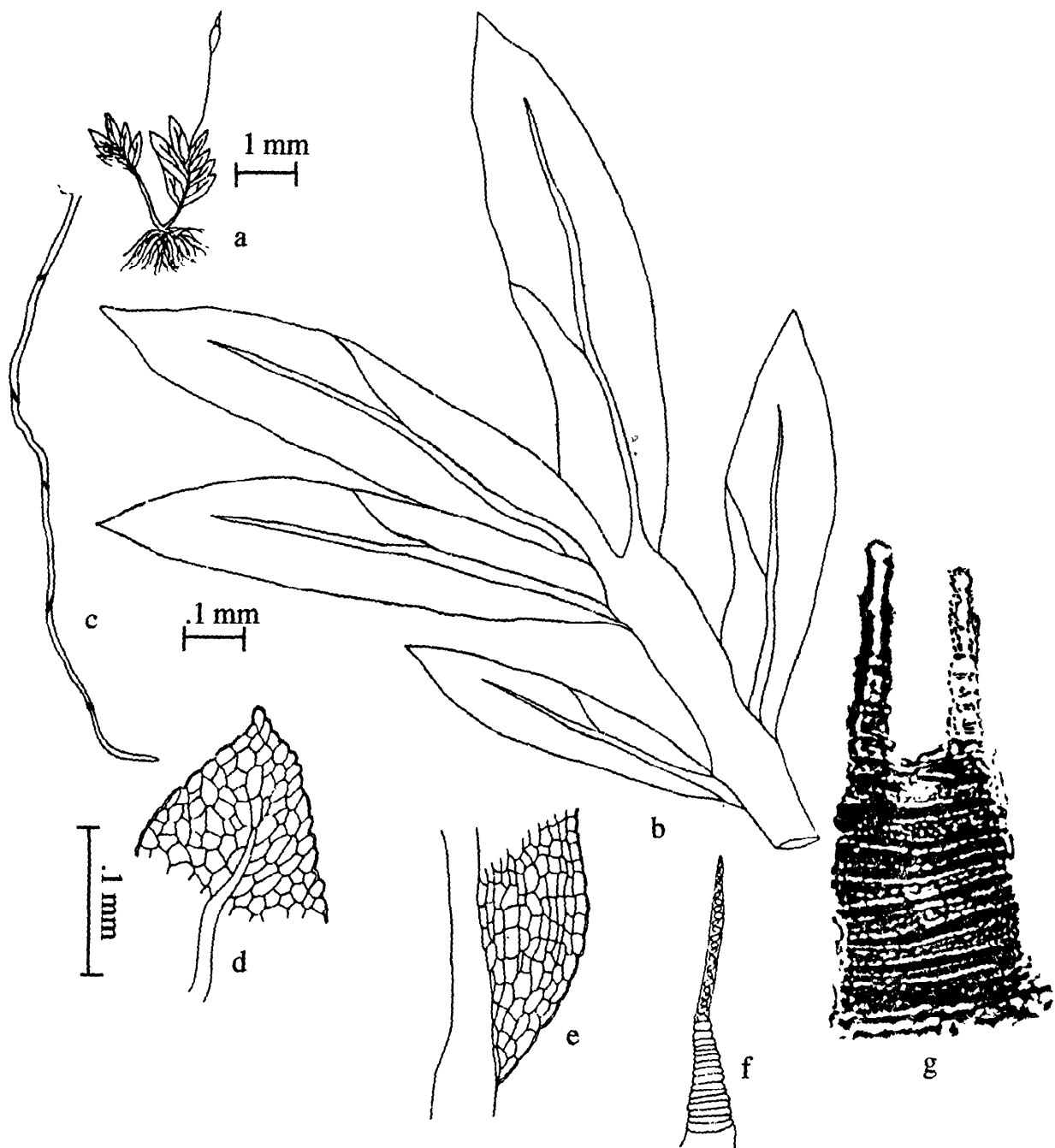


Fig.11-a-f: *Fissidens splachnobryoides* Brotherus.; a, b. Plant body; c. Rhizoid; d. Leaf apex; e. Leaf base; f. Peristome teeth; g.: *Fissidens subpalmatus* C. Mueller.; Dicranoid haplolepideous peristome tooth.

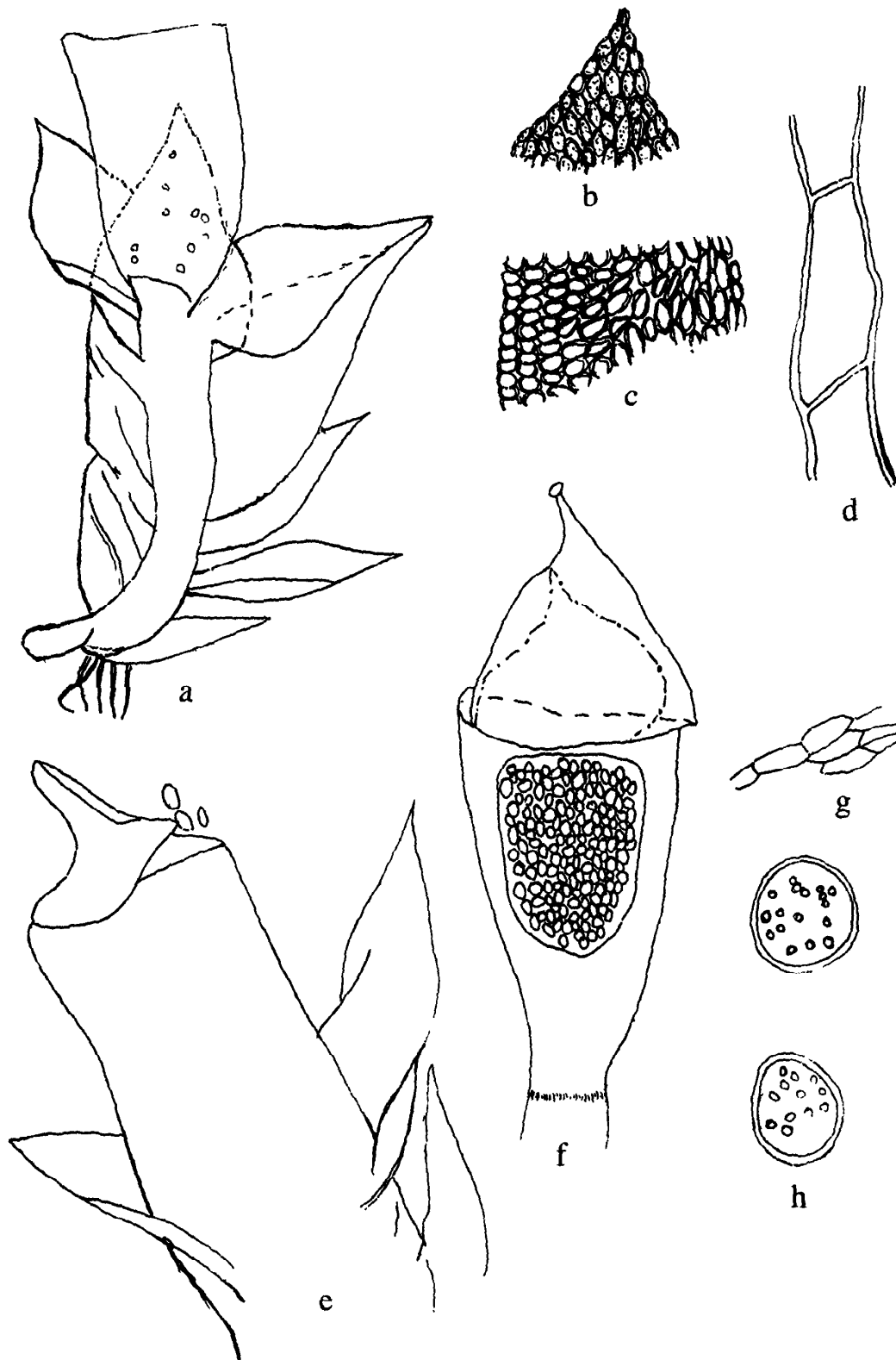


Fig. 12. a-h.: *Erpodium mangiferae* C. Muell.: a. Fruiting branch: orthotropous, ephemeral ($\times 63$); b. Leaf apex ($\times 250$); c. Leaf base ($\times 250$); d. A portion of rhizoid ($\times 1200$); e. Dehiscing capsule with operculum ($\times 150$); f. Young capsule showing operculum and calyptra ($\times 150$); g. Capsule wall cells ($\times 150$); h. Spores ($\times 500$).

- 1b. Plants luxuriant; costa sturdy 2
- 2a. Leaf cells mamilllose; peristome absent;
plants usually branched HYOPHILA
- 2b. Leaf cells papillose; peristome present in
one ring (haplolepideae) and shred into filaments;
plants apparently unbranched. 3
- 3a. Plants softer; peristome teeth long papillose threads,
twisted together and wound like a cork-screw;
leaf cells mostly translucent HYDROGONIUM
- 3b. Plants stiffer; peristome teeth reduced,
short papillose threads, too short to be spirally twisted;
leaf cells more or less opaque SEMIBARBULA

Gymnostomiella Fleischer

Gymnostomiella vernicosa (Hook.) Fleischer in Musci Fl. Buitenzorg 1: 310. 1904; Gangulee, Mosses of Eastern India, etc. 4:861-863. 1974: *Gymnostomum vernicosum* Hook. Icon. Pl. Rar., 1: 17. 1836. (Fig. 13. a-i.)

Delicate plants in small patches. Stem filiform, up to 2 cm long, rediculose at the base, with a terminal rosette of leaves. Leaves erect to nearly horizontal-spreading, concave, spatulate, from a sheathing base, broad, rounded; margin entire but rough, warty in the upper half; apex obtuse or rounded; costa faint, ending near mid-leaf; basal cells elongated, rectangular, smooth, hyaline; upper cells large, quadrate to hexagonal, with firm yellowish walls, sparsely warty papillose. Gemmae clavate to barrel-shaped, on the rhizoids or rosette of leaves. Not found fruiting.

Habitat : Common on moist dilapidated shaded walls. Rarh 408! Golapbag; 628! Nutanganj.

Distrib. : India : Western Himalayas, Uttar Pradesh, Madhya Pradesh, Western Ghats, Rarh Bengal, Bihar (Ranchi); Myanmar, Singapore, Indonesia, Philippines. A South and East Asiatic species.

Hydrogonium (C. Mueller) Jaeger

Key to the species

- 1a. Upper lamina cells not papillose or scarcely so. Leaf tip acute *H. arcuatum*
- 1b. Upper lamina cells highly papillose. Leaf tip rounded *H. consanguineum*

Hyogonium arcuatum (Griffith) Wijk. & Marg. in Taxon 7: 289. 1958; Gangulee, Mosses of Eastern India, etc. 3: 724-727. 1972. Tan & Iwatsuki in J. Hattori Bot. Lab. 74: 357. 1993. *Barbula arcuata* Griffith in Calcutta J. Nat. Hist. 2: 491. 1842.

Dioicous. Plants more or less stiff, tufted, yellowish green. Stem *ca* 1 cm high, brown, usually unbranched, uniformly covered with leaves. Peristome teeth + 1 mm high, filiform papillose, spirally twisted 2-3 turns, red-brown. Spores round to oval yellowish pellucid, 11-12 μ m in diameter. Fruiting time: September-November. Gemmae present in leaf axis, oval to star shaped.

Habitat : Terrestrial to rupestrine plants. Rarh 721! Durgapur.

Distrib. : India: Western Himalayas, Kashmir, Upper Gangetic Plains; South India, Rarh Bengal, Assam, Arunachal, Orissa, Madhya Pradesh; Myanmar, Malaysia, Indonesia, Philippines, China, Japan, Oceania. An East and South-East Asiatic species.

Hyogonium consanguineum (Thw. & Mitt.) Hilp. in Beih. Bot. Centrabl. 50(2): 626. 1933; Gangulee, Mosses of Eastern India, etc. 3: 729-730. 1972. *Tortula consanguinea* Thw. & Mitt. in J. Linn. Soc. 13: 300. 1873.

Dioicous. Plants slender, in dense tufts, yellow-green. Male plants smaller; antheridia in orange axillary buds, stalked, club shaped, mixed with simple filamentous brown paraphyses. Female plants *ca* 2 cm high, unbranched. Leaves somewhat stiff, tips incurved. Fruiting time: September to November.

Habitat : Tufted moss on soil. Rarh 722! Durgapur.

Distrib. : India: Darjeeling, Rarh Bengal, Upper Gangetic Plains. Western-Central & South India; Sri Lanka, East Nepal, Myanmar, Thailand, Vietnam, Malaysia, Singapore, Indonesia, New Guinea, Philippines, China, Taiwan: An Indomalaysian species.

Hyophila Bridel

Hyophila involuta (Hook) Jaeg. Ber. S. Gall. Naturw. Ges. 1871-72: 356. 1873; Gangulee, Mosses of Eastern India, etc. 3: 681-683. 1972. Tan & Iwatsuki in J. Hattori Bot. Lab. 74: 358. 1993. *Gymnostomum involutum* Hook. in Mus. Exot. 2: 154. 1819. (Fig. 14 a-i.)

Dioicous. Plants forming dense tufts of dark green patches on bricks and rocks. Rhizoids deep brown. Leaves erect-spreading, oblong-ligulate, carinate; apex broadly pointed, denticulate; margin entire below; costa prominent, wider at base, percurrent. Leaf base cells pale, rectangular, smooth; upper lamina cells rounded, mamillate, chlorophyllose. Calyptra cucullate. Seta apical, erect. Capsule erect, cylindrical, brown. Annulus 1 or 2 rows of very thick-walled, lenticular cells. Peristome absent. Operculum conical, rostrate. Spores globose, dirty brown, pellucid. Fruiting July-November.

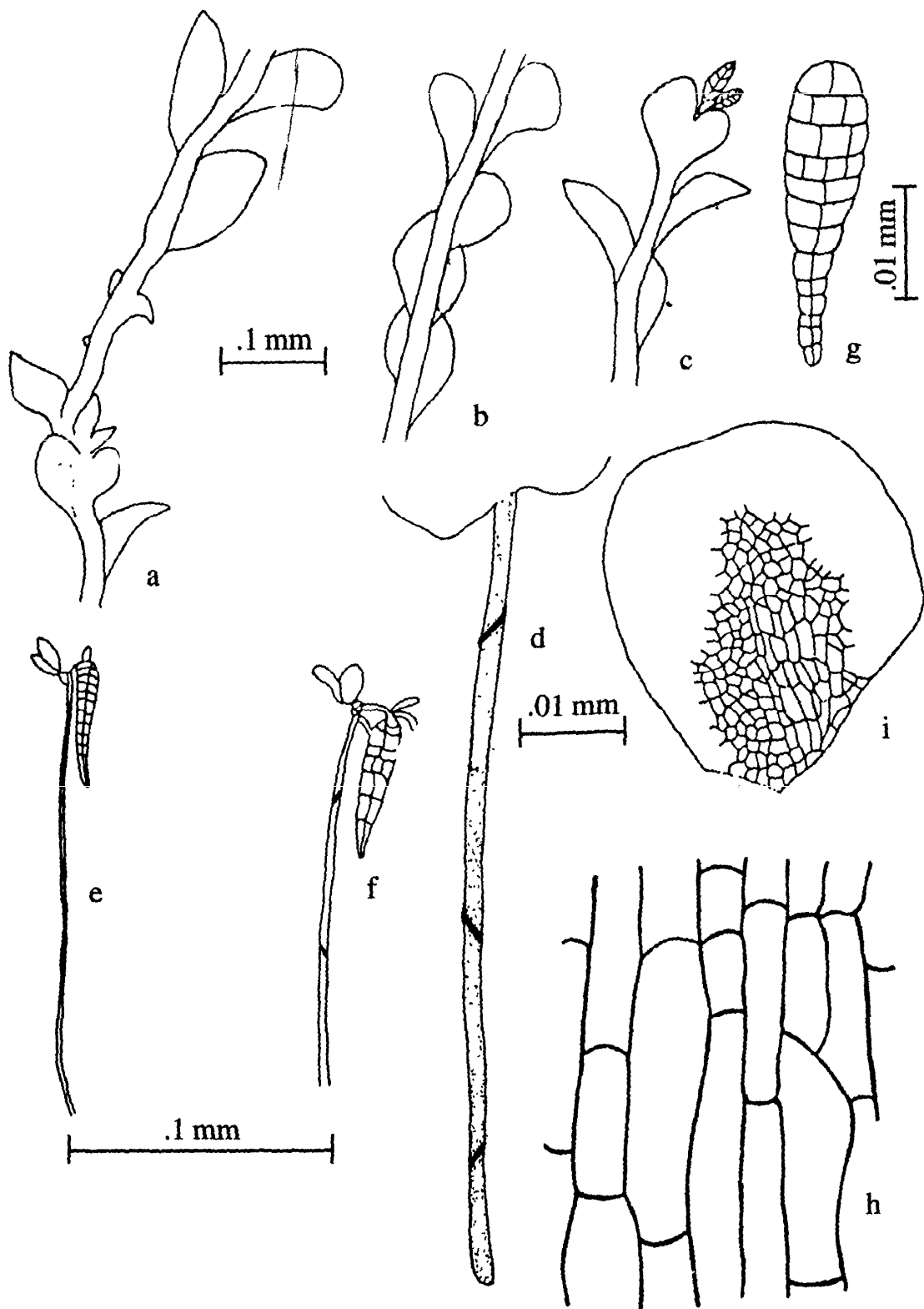


Fig. 13. a-i.: *Gymnostomiella vernicosa* (Hook.) Fleisch.: a-c. Sterile plant body; d. Rhizoid; e, f Gemmae on sterile plant; g. Gemma; h. Epidermal cells (surface view); i. An entire leaf.

Habitat : On soil at higher elevation. Rarh 503! Asansol; 609! Durgapur.

Distrib. : Throughout India (including Nicobar Island), South-East Asia, Europe and America. Almost cosmopolitan.

Semibarbula Hilpert

Semibarbula orientalis (Weber) Wijk. *et* Marg. in Taxon, 8: 75. 1959; Gangulee, Mosses of Eastern India, etc.3: 717-719. 1972. Tan & Iwatsuki in J. Hattori Bot. Lab. 74: 382. 1993. *Trichostomum orientale* Weber in Arch. Syst. Nat 1: 129.1804. (Fig. 14. j.)

Dioicous. Plants forming dense green patches on dilapidated walls. Leaves lax (clustered near top), spiral, oblong to ovate-lanceolate, erecto-patent, carinate; margin papillose, unbroken usually flat; apex blunt. Leaf base covering the lowest quarter; cells large, rectangular, hyaline up to $42 \times 8.4 \mu\text{m}$. Upper lamina cells obscure, rounded-quadrate-hexagonal, 5 to $8 \mu\text{m}$ wide, multipapillose, chlorophyllose. Gemmae multicellular, abundant in clusters. Calyptra cucullate. Seta apical, 4-7 mm long. Capsule erect, cylindrical, reddish brown. Peristome split into 32 short, filamentous segments covered with dense, minute papilli all over the surface. Operculum conic, short, rostrate. Spores round, smooth, yellowish pellucid. Fruiting time: October to December.

Habitat : Common in shaded rice fields. Bhatia. 232! Chottabelun; Rarh 482! Karjona, 608! Golapbag; Kaustuv, 107! Durgapur.

Distrib. : Throughout India, from plains to 2000 m; East Nepal, South-East Asia, Central and South Africa, Oceania.

CALYMPERACEAE

Octoblepharum albidum Hedw. in Sp. Muse. 50. 1801. Gangulee, Mosses of Eastern India, etc. 2: 439-441. 1971; Chopra, Taxonomy of Indian Mosses. 94. 1973. Tan & Iwatsuki in J. Hattori Bot. Lab. 74: 370. 1993. *Bryum albidum* L. Sp. Pl.: 15883.1753. *nom. invalid* (Art 13.1).

Autoicous. Plants epiphytic in whitish mats, sometimes tinged with brown at leaf tips. Leaves spirally arranged, usually forming a rosette near tip, apiculate, multistratose; cells usually differentiated into chlorocysts and leucocysts. Costa without a middle-stereome. Chlorocysts at least in the upper part, three sided as seen in transverse section of the leaf, one layered throughout and each is bounded by 3 leucocysts. Leaf base flanked by 5 to 9 rows of hyaline laminar cells of which the inner rows, rectangular-narrow liner to rhomboidal. Outer linear rows persist to the tip of the leaf. Seta apical, +5 mm long. Capsule erect, oblong-ovoid, symmetrical. Peristome fused into 8 segments ($110 \mu\text{m}$ long and $167 \mu\text{m}$ wide at base). Operculum conical, $1/2$ to $2/3$ of urn in height. Calyptra cucullate, entire at base, covering about $2/3$ area of urn. Spore oval, finely papillose, 19-21 μm in diameter, light brown. Fruiting in October.

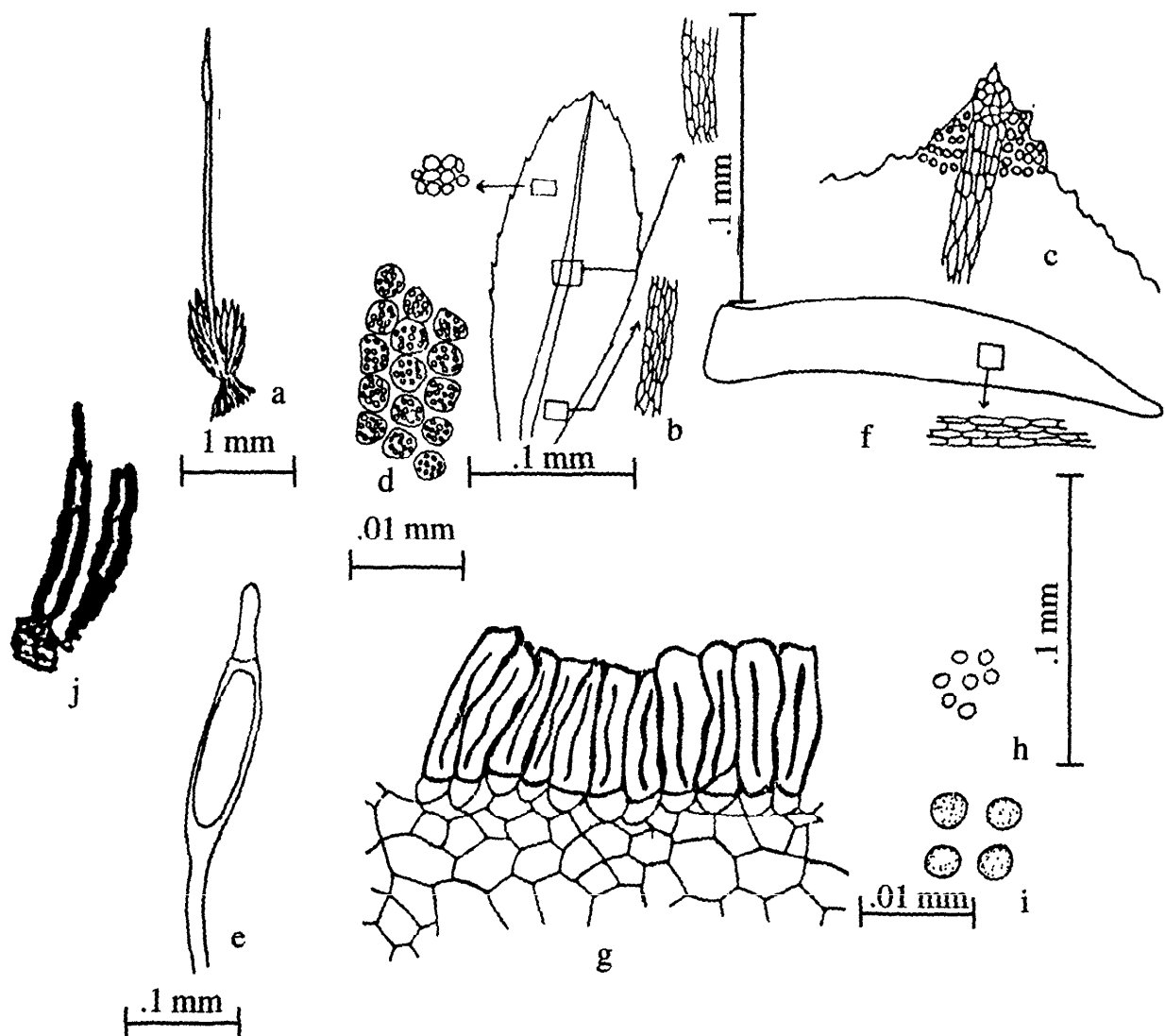


Fig. 14. a-j.: *Hyophila involuta* (Hook.) Jaeg.: a. Plant body; b. Leaf and leaf cells; c. Leaf apex; d. Chloroplasts of leaf cells; e. Capsule; f. Calyptra; g. Annulus; h, i. Spores j. *Semibarbula orientalis* (Weber) Wijk et Marg.: Papillose, haplolepideous peristome teeth (too short for any coiling).

Habitat : Densely tufted, medium to large (ca 2 cm high), epixylic mosses with persistent protonemata upon the dead, decaying branches of large trees. Kaustuv 104!, 105! Golapbag, Burdwan.

Distrib. : India: Rarh Bengal, Howrah, Darjeeling, Orissa, Assam, Andaman and Great Nicobar Islands, South India; Tropical and subtropical countries of Asia, Africa, America and Australia. Almost a subcosmopolitan moss.

ORDER-4: BRYALES

BRYACEAE

Bryum coronatum Schwaegr., in Suppl., 1(2): 103.1816; Gangulee, Mosses of Eastern India, etc. 4: 1002-1003.1974. Tan & Iwatsuki in J. Hattori Bot. Lab. 74: 335. 1993.

Dioicous. Plants densely, tufted, slender, growing on damp walls, bricks or calcareous soil, bright to dull green, tomentose at base. Stem often branched at base, up to 2 cm high, with a central strand. Leaves in three or more rows like ordinary mosses. Lower leaves small. Upper leaves ovate to oblong-lanceolate, erect to erecto-patent, long acuminate. Margin entire, flat. Costa strong, reddish at base, excurrent, in a mildly denticulate arista. Upper leaf cells broader, usually rhomboid. Perichaetial leaves shorter, triangular. Seta apical, erect, but arcuate at tip, red to purple, up to 3 cm long, vaginula ovoid. Capsule nodding, red to purple; mouth wide. Operculum big, conical. Annulus 2-3 rowed. Peristome teeth in two rings; exostome teeth alternating with endostome teeth. Spores globose, small, 7.5-11.4 µm in diameter.

Habitat : Densely tufted, medium to large mosses on damp calcareous soil or walls. Gangulee 6294! Burdwan (CAL).

Distrib. : Like some other mosses (Tan & Pocs, 2000), this species has become adapted to man-made habitats and is found more commonly around human settlements than in their natural habitats. Throughout India, from plains to 1500 m. East & South-East Asia, Central & South Africa, North-Central & South America, Australia, Oceania.

ORDER-5: HYPNALES

SEMATOPHYLLACEAE

Taxithelium nepalense (Schwaegr.) Brothers, in Monsunia 1: 51.1899; Chopra, Taxonomy of Indian Mosses, 518-519.1975; Gangulee, Mosses of Eastern India, etc. 8: 1920-1921. 1980. Tan & Iwatsuki in J. Hattori Bot. Lab. 74: 388. 1993. *Hypnum nepalense* Schwaegr. Sp. Musc. Suppl. 3(1): 226.1828. (Fig. 15. a-r.)

Autoicous. Pleurocarpous, robust moss forming a dense yellowish green tufts. Stems

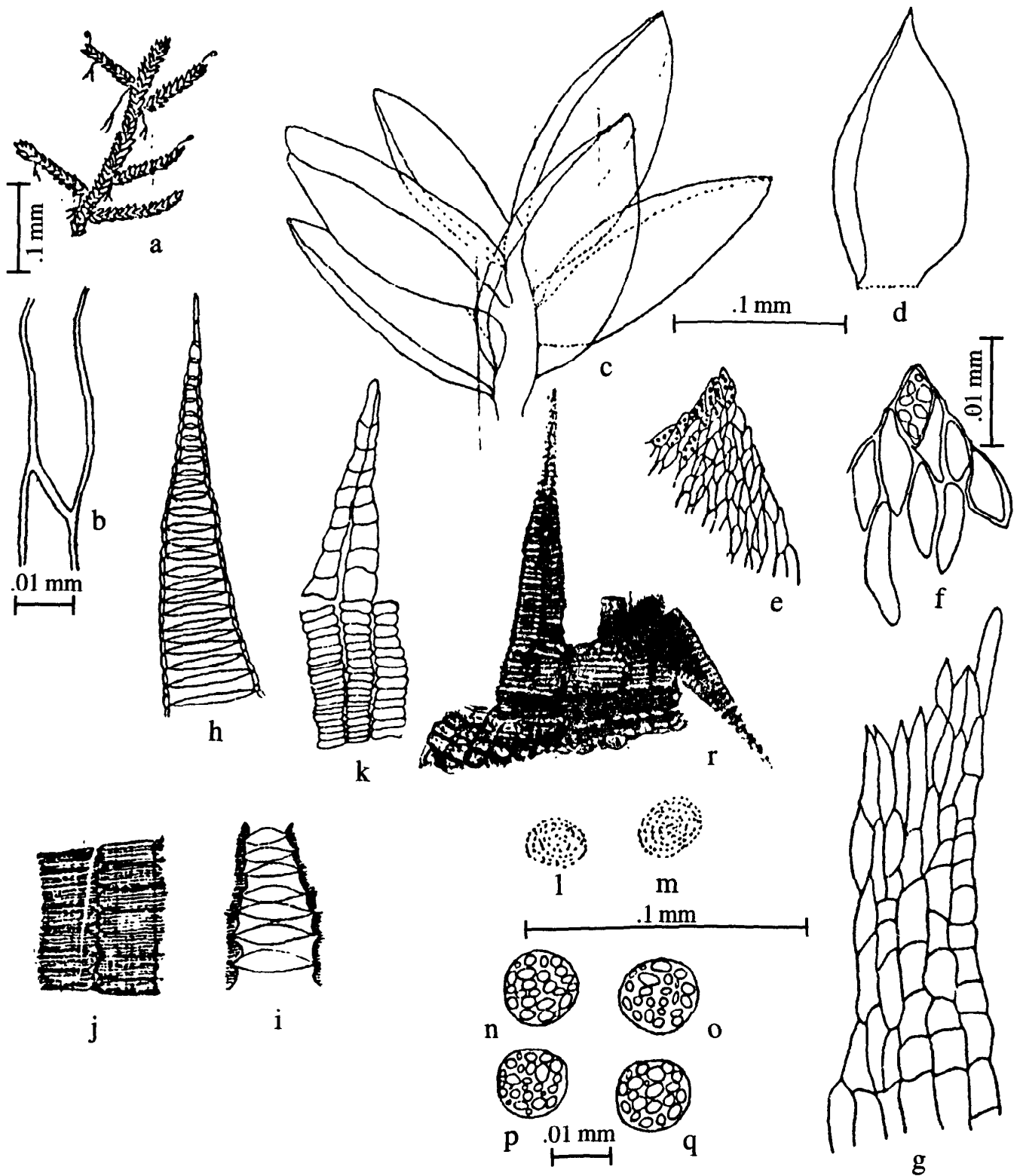


Fig. 15. a-r.: *Taxithelium nepalense* (Schwaegr.) Brothers.; a. A part of the pleurocarpous moss; b. Rhizoid; c. Plant showing arrangement of leaves; d. Leaf; e, f. Part of leaves, showing chloroplast arrangement; g. Leaf base showing cellular arrangement; h-j. Outer peristome teeth; k. Inner peristome teeth; l-q. Spores; r. Metacranoid peristome teeth.

monopodially branched. Leaves dense, erecto-patent, strongly concave, ovate with acute tips, + 1.15mm long and 0.45 mm wide; margin faintly denticulate at top, flat; costa none. Laminal cells mostly spindle-shaped ($+38 \times 6 \mu\text{m}$), with one longitudinal row of firm papillae; alar and attachment cells smooth, well differentiated, large rectangular. Sporophytes on main stem. Perichaetial leaves long, narrow, erect. Seta erect, + 1.7 cm long, smooth. Capsule curved, oval, + 1.28 mm long and 0.5 mm in diameter. Annulus persistent. Operculum conical, apiculate. Calyptra cucullate, smooth. Peristome metacranoid, of equal height, ($+330 \mu\text{m}$ high), cilia single, basal membrane high. Spores oval, 13 to 18 μm in diameter, round, pellucid, brownish. Gemmae absent. Fruiting time: July to September.

Habitat: Epiphytic (corticolous) on tree bases and damp dilapidated wells.

Distrib.: India: Gangetic plain -West Bengal, North Bengal, Maghalaya, Orissa, Assam, Tamil Nadu, Andaman and Nicobar Islands; Sri Lanka, Nepal, Bangladesh, Myanmar, Thailand, Malaysia, Indonesia, Philippines, New Guinea, Fiji, Tasmania, Central Africa. A disjunctively distributed species.

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वर्धमान जिला, पश्चिम बंगाल का हरितोद्भिद वनस्पतिजात

पी.के. भट्टाचार्य

सार संक्षेप

वर्धमान जिला, पश्चिम बंगाल के हरितोद्भिद वनस्पतिजात पर प्रस्तुत आलेख में प्राथमिक जानकारी के रूप में 13 कुलों के 18 जेनेरा के अन्तर्गत कुल 26 जातियों के विवरण हैं। प्रत्येक जाति के संगत फिल्ड डाटा आवश्यक इलस्ट्रेशन तथा डायग्नोस्टिक फीचर (वृत्तान्त) दिए गए हैं। भारतीय वनस्पतिजात के ज्ञान अभिलेख में *आर्किलेजेउनिया प्लेनिजस्कूला* (मिट्ट) स्टैफ तथा *लेजेउनिया बोनिनेंसिस* हरिकावा नये नाम होंगे।